Neal Smith National Wildlife Refuge Research Reporting Symposium

February 24, 2006

Prairie and Savanna
Land Management and Research
Demonstration Program

Region 3, USFWS

Evaluating restoration success: roles of grazing and seed limitation.
Brian J. Wilsey

Integrated Resource Assessment during a Tallgrass Prairie Reconstruction within a Small Watershed. Cambardella/Tomer

Oak savanna restoration at Neal Smith National Wildlife Refuge: Overview and degraded understory assessment. Lars Brudvig

Ecosystem structure and function in watersheds with contrasting annual-perennial plant community configurations. Heidi Asbjornsen, Matt Helmers, Lisa Schulte

Comparative Ecosystems Study: Ecohydrological functioning of contrasting annual and perennial systems. Heidi Asbjornsen, Tom Sauer

Soil Carbon Change within Reconstructed Tallgrass Prairie Ecosystems.
Cindy Cambardella

The Effects of Neal Smith NWR's EE Programs on Elementary School Classes' Knowledge and Attitudes. Jason O'Brien

The effects of varying seeding rates of *Bouteloua curtipendula* and mowing on native plant establishment in a new prairie reconstruction. Ryan Welch

Soil Physical/Chemical Property changes During Prairie Restoration.
Beth Larabee (Dr. Mahdi Al-Kaisi)

Survey of Mycorrhizal Symbiosis at Neal Smith National Wildlife Refuge.
Scott Bryant

Beyond site-specific assembly rules: species traits predict occurrence of Lepidoptera in restored Tallgrass prairies.
Keith Summerville

Evaluation of Isolated and Integrated Prairie Reconstructions as Habitat for Prairie Butterflies. Diane Debinski.

Contribution of Stream Bank Erosion to Suspended Sediment in Walnut and Squaw Creek. Tom Isenhart

Insects, Prairie Restoration, and Prescribed Burning.
Steve Spangler

Walnut Creek Watershed Monitoring Project, 1995-2005: Project Results and Riparian Zone Studies. Keith Schilling

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Abstracts of Presentations

ECOSYSTEM STRUCTURE AND FUNCTION IN WATERSHEDS WITH CONTRASTING ANNUAL-PERENNIAL PLANT COMMUNITY CONFIGURATIONS

Heidi Asbjornsen[1], Matt Helmers[2], Matt Liebman[3], Lisa Schulte[1], Rick Cruse[3], Randy Kolka[4], Mark Tomer[5], Cindy Cambardella[5], Keith Schilling[6], Jean Opsomer[7], Pauline Drobney[8], Cathy Kling[9], Silvia Secchi[9], Matt O'Neal[10]

[1]ISU-Natural Resource Ecology and Management, [2]ISU-Agricultural and Biosystems Engineering, [3]ISU-Agronomy, [4]U.S.D.A. Forest Service, North-Central Station, [5]U.S.D.A. National Soil Tilth Lab, [6]Iowa Department of Natural Resources, Geologic Bureau, [7]ISU-Statistics, [8]U.S. Fish and Wildlife Service, [9]ISU, Center for Agricultural and Rural Development, [10]ISU, Entomology

In this study we will examine nutrient, water and carbon cycling processes within replicated subwatersheds that comprise different configurations of annual and perennial plant communities, ranging from conventional row crops to mixed annual and perennial systems. The mixed annual-perennial system is designed to provide optimal benefits in terms of both productive capacity and improved water quality and flow. Replicated treatments will be implemented in a series of subwatersheds located at the Neal Smith National Wildlife Refuge (hereafter, Neal Smith NWR) in the Walnut Creek watershed in Jasper County in central Iowa. Experimental investigations will occur in concert with calibration and validation of soil, plant, and hydrologic models to assess water, nutrient and carbon fluxes, with an aim to develop landscape level tools for sustainable agroecosystem design. These experiments will provide valuable data for accurately parameterizing watershed and landscape models (especially for non-conventional land cover types). The Neal Smith NWR will serve as a demonstration site and training location for this work that is in close proximity to policy-makers in Des Moines, and also easily accessible to farmers, educational institutions, natural resource management professionals and the general public. The project is also developing a social and educational component that will provide research-based findings about strategies for successfully communicating scientific dimensions of study findings to landowners, decision makers, and the public based on conceptual change theory.

COMPARATIVE ECOSYSTEMS STUDY: ECOHYDROLOGICAL FUNCTIONING OF CONTRASTING ANNUAL AND PERENNIAL SYSTEMS

Researchers: Heidi Asbjornsen, Matt Helmers, Randy Kolka, German Mora, Tom Sauer

Graduate students: Melissa Cheatham, Ryan Maher, Greg Shepherd

This research focuses on understanding the ecohydrological functioning of dominant annual (corn, soybeans) and perennial (reconstructed prairie, restored oak savanna, woodland, brome pasture) systems in Central Iowa. During the initial phase of this project, we are focusing on establishing baseline data and development field methodologies for measuring the following five ecosystem processes within these systems: 1) plant transpiration, 2) micrometeorological fluxes, 3) depth of plant water uptake, 4) modeling plant diversity-function relationships, and 5) soil respiration and root productivity. Knowledge about the spatial and temporal patterns in ecohydrological processes within these ecosystems will provide a basis for making more informed decisions for integrating perennial plants within agricultural landscapes to enhance environmental benefits, especially related to water, nutrient, and carbon cycling. Once field methodologies are established, this research will be expanded and applied to a larger number of sites at the Refuge in order to better understand landscape scale variability.

OAK SAVANNA RESTORATION AT NEAL SMITH NATIONAL WILDLIFE REFUGE: OVERVIEW AND DEGRADED UNDERSTORY ASSESSMENT

Lars Brudvig, Iowa State University PhD Candidate.

Oak savannas of the prairie/forest transition zone were historically prominent components of the Midwestern landscape, including the area currently encompassing Neal Smith National Wildlife Refuge. These ecosystems are typified by scattered oak trees and a continuous herbaceous and woody understory; however, fire suppression has resulted in woody encroachment in a vast majority of oak savannas. To ascertain the effects of mechanical tree removal and prescribed fire, a one ha restoration within an eight ha bur oak savanna was initiated in winter 2003-04. An additional one ha is studied as a control within the same savanna remnant. Thus far, researcher have investigated impacts on vegetation and soil by both nested linear transect and U.S. Forest Service Forest Inventory and Analysis methodologies, as well as the consequences of restoration on hydrologic regime. To guide restoration, we compared lists of understory species from this and seven other degraded central Iowa oak savanna remnants to reference species lists. We recommend that tree seedlings and woody vines be reduced and that conservative and high-light specialist perennial forbs be promoted. As a majority of species from reference lists are passively dispersed, we suggest that species may need to be actively reintroduced, to achieve these goals.

SOIL CARBON CHANGE WITHIN RECONSTRUCTED TALLGRASS PRAIRIE ECOSYSTEMS

C. A. Cambardella, T. M. Isenhart†, K. E. Schilling‡, P. Drobney††, P. Jacobson‡‡, and R. C. Schultz†*

* *USDA-ARS, National Soil Tilth Laboratory, Ames, IA; † Department of Natural Resource Ecology and Management, Iowa State University, Ames, IA; ‡ Geological Survey Bureau, Iowa DNR, Iowa City, IA; †† US-FWS, Neal Smith National Wildlife Refuge, Prairie City, IA; ‡‡ Department of Biology, Grinnell College, Grinnell, IA.*

Reconstructing disturbed prairie ecosystems to the native state can potentially result in large increases in soil carbon. We quantified soil profile carbon at Neal Smith National Wildlife Refuge near Prairie City, IA to determine the effect of time since prairie reestablishment on soil carbon accumulation. Blocks of land have been reconstructed to native prairie at the refuge every year since 1993. We used a stratified sampling design to identify sampling locations within 6 reconstructed areas, 3 native remnant areas, and 2 cultivated areas blocked by 3 upland soil types. Geographic information system coverages of all possible sampling locations were created and an area grid and random number generator were used to select exact sampling locations. Geographic positioning system coordinates were used to locate sampling sites in the field. Soil cores were collected in May of 2000 to a depth of 120 cm using a truck-mounted or modified, hand-held soil sampler. We quantified total soil organic C (SOC), bulk density, and soil texture for 5 depth increments (0-15, 15-30, 30-60, 60-90, and 90-120 cm) and particulate organic matter C (POM C), a form of biologically-active soil organic matter, to a depth of 15 cm. DOC is currently being analyzed. Total SOC to a depth of 120 cm averaged across all sites ranged from 77.9 to 105.5 Mg C ha^{-1}. POM C in the top 15 cm ranged from 3.23 to 4.89 Mg C ha^{-1} averaged across all sites. We did not observe a consistent positive change in SOC or POM C at any depth with time since prairie reconstruction. Cultivated or remnant sites did not have consistently less or more soil carbon than reconstructed sites. Variability was relatively high despite the stratified design. Landscape-scale changes in SOC are difficult to detect over the short term, primarily due to landscape-scale spatial heterogeneity and inconsistent impacts of historic management practices on current soil C stocks. Normalized surface SOC, expressed as the difference in SOC between top 2 depths, was positively correlated with time since prairie reconstruction, suggesting this variable is a sensitive indicator of C change along the reconstruction chronosequence. The ratio of heavy sub-fraction POM C to light sub-fraction POM C was 2X greater for the oldest compared to the younger reconstructions and 3X greater than the farm sites, suggesting that disturbed soils are depleted in heavy POM C. Accumulation of C in the heavy POM sub-fraction may serve as an early indicator of ecosystem change in during prairie reconstruction. We sampled the reconstruction chronosequence again in June 2005 to evaluate changes in profile SOC since May 2000. New sampling sites were located within reconstructions that had been established from 2000 through 2004. Intensive soil, plant and hydrologic evaluation was

initiated within a small watershed that was planted to native grasses in December 2003 (Cabbage Site). Information from this 12-ha area will provide critical baseline information for evaluation of C changes for Walnut Creek watershed as a whole and an integrated assessment of soil, hydrologic and groundwater processes.

INTEGRATED RESOURCE ASSESSMENT DURING A TALLGRASS PRAIRIE RECONSTRUCTION WITHIN A SMALL WATERSHED

Cindy Cambardella[1], Mark Tomer[1], Keith Schilling[2], and Peter Jacobson[3]
1 - USDA/ARS National Soil Tilth Laboratory; 2 – Iowa DNR, Geological Survey Bureau; 3 – Grinnell College

This research is aimed to track changes in soils, vegetation, and hydrology during the transition from agricultural land to a reconstructed prairie. The 20 acres site was seeded to a broad mix of tall grass prairie species during Autumn 2003. Soil cores were collected, and soil water samplers, runoff collectors, and groundwater monitoring wells were installed. In addition, vegetation monitoring transects were installed, and installation of two surface runoff flumes is planned for 2006. The paired flumes will be calibrated during the next few years, providing reference data for a future paired watershed study to evaluate bison grazing impacts on the prairie vegetation, soils, and runoff, and groundwater. This presentation will cover the experimental design and provide some preliminary results.

CONTRIBUTIONS FO STREAM BANK EROSION TO SUSPENDED SEDIMENT IN WALUNT AND SQUAW CREEK

T. Isenhart[1], J. Palmer[1], D. Heer[1], R. Schultz[1], and K. Schilling[2]

[1]Department of Natural Resource Ecology and Management, Iowa State University

[2]Iowa Geological Survey and Land Quality Bureau, Iowa Department of Natural Resources

Modeling of changes in gross sediment erosion occurring in Walnut and Squaw Creek watersheds from 1990 to 2005 conducted by IDNR indicates that total gross erosion was reduced by 37 percent for Walnut Creek, while increasing 15 percent in Squaw Creek. The main reason for the change is attributed to the decrease in row crop acreage in Walnut Creek and the increase in row crop acreage in Squaw Creek over this period. However, suspended sediment loads measured at the two watershed outlets did not show significant differences from 1995 to 2005 despite the landuse changes. It is hypothesized that sediment sources are different in Walnut compared to Squaw, with streambank erosion playing a significantly greater role in sediment delivery in Walnut Creek watershed. Ongoing studies are attempting to evaluate the contributions of sediment from the landscape and stream banks to the suspended sediment load using several techniques.

1. Relative channel stability was determined by ground reconnaissance of main stem and tributary channels using GPS to mark severely eroding stream banks.
2. Recession rates of stream banks with differing adjacent land use are being estimated using erosion pins and permanent cross sections.
3. Continuous water table monitoring within differing riparian land use is being conducted to determine the effect of major vegetation communities on depth to water table and soil strength.
4. Naturally occurring radionuclides (7Be and 210Pb) will be used as tracers to provide information regarding the sources of the sediment transported in streams.

Results of the research will provide a quantitative evaluation of the role of channel processes and stream banks in total suspended sediment transport in Walnut and Squaw Creek watersheds. Information on the proportions of sediment eroded from fields and streambanks and the role of riparian vegetation will assist in efficient development of management practices.

THE EFFECTS OF NEAL SMITH NWR'S ENVIRONMENTAL EDUCATION PROGRAMS ON ELEMENTARY SCHOOL CLASSES' KNOWLEDGE AND ATTITUDES

Jason O'Brien, Iowa State University Extension

In 1997, the Neal Smith National Wildlife Refuge-Prairie Learning Center began offering on-site environmental education (EE) to school groups visiting their reconstructed tallgrass prairie. To evaluate the EE program, fourth-, fifth- and sixth-grade classes from central Iowa completed a pre- and post-visit knowledge and attitudes survey and results were compared with similar classes that did not visit the refuge. Results indicate a significant increase in knowledge and a positive change in attitudes in the treatment group two weeks after visiting the refuge compared with the control group. This research also tested the effectiveness of hands-on stewardship activities in changing knowledge and attitudes. No differences were detected in either knowledge or attitudes between treatment classes that participated in stewardship activities and treatment classes that did not.

WALNUT CREEK WATERSHED MONITORING PROJECT, 1995 – 2005: PROJECT RESULTS AND RIPARIAN ZONE STUDIES

Keith Schilling, [2]Iowa Geological Survey and Land Quality Bureau, Iowa Department of Natural Resources

The Walnut Creek Watershed Restoration and Water-Quality Monitoring Project provides a valuable opportunity to measure quantitatively, on a watershed scale, water quality improvements resulting from large-scale land use changes. The project was established in 1995 as a NPS monitoring program in conjunction with watershed habitat restoration and agricultural management changes implemented by the U.S. Fish and Wildlife Service (USFWS) at the Neal Smith National Wildlife Refuge in Jasper County Iowa. A large portion of the Walnut Creek watershed is being restored from row crop agriculture to native prairie and savanna. The project utilizes a paired-watershed design as well as upstream/downstream comparisons for analysis and tracking of trends. Four basic components have comprised the project: 1) tracking of land cover and land management changes within the basins, 2) stream gauging for discharge and suspended sediment at two locations on Walnut Creek and one on Squaw Creek, 3) surface water quality monitoring of Walnut and Squaw Creeks, and 4) biomonitoring for benthic macroinvertebrates and fish in Walnut and Squaw Creeks. Project results are reported for discharge and suspended sediment, and nitrate concentrations.

Discharge and suspended sediment transport was very flashy with much of the sediment export occurring during occasional events primarily in May and June of each year. Sediment erosion modeling suggested that sheet and rill erosion in Walnut Creek was reduced greatly due to prairie restoration compared to 1990 levels and conditions in Squaw Creek. However, sediment export in both watersheds was nearly identical and related significantly with discharge.

Project results indicate that prairie restoration in an agricultural watershed can improve water quality with regards to nitrate concentrations and loads. Replacement of 17 percent of row crop lands in Walnut Creek watershed with native prairie (23 of the watershed planted in prairie) resulted in a reduction of nitrate of approximately 1.1 mg/l over 10 years. Upstream contributions from tile-drained, upland row crop areas had a significant effect on downstream water quality such that prairie restoration occurring in the core of the watershed primarily had the effect of diluting upstream nitrate contributions. Nonetheless, native prairie restoration should be viewed as a viable conservation strategy for improving water quality in streams. Project results highlighted the close relation of stream nitrate concentrations to land use change from row crops to grasslands. In Walnut Creek, converting row crop to grass reduced nitrate concentrations over time, but in Squaw Creek, stream nitrate concentrations rapidly increased when grasslands were converted back to row crop.

Near the Walnut Creek stream channel, a transect of monitoring wells was established to evaluate the effects of sedge meadow reconstruction on riparian water table levels. Water level and water quality monitoring at the riparian transect have examined 1) the effects of channel incision on riparian water table fluctuations and surface water-groundwater interactions during storm events; 2) effects of land cover on soil moisture, evapotranspiration and recharge; and 3) effects of floodplain lithology and land management on nutrient loading patterns. Elsewhere, groundwater research has quantified water table fluctuations under three riparian land covers (grass, corn and forest) to determine how vegetation affects water table dynamics in riparian zones of streams.

EVALUATION OF ISOLATED AND INTEGRATED PRAIRIE RECONSTRUCTIONS AS HABITAT FOR PRAIRIE BUTTERFLIES

Shepherd, S. and D.M. Debinski. Iowa State University.

Reconstructing prairie habitat is one of the most promising techniques for conserving the imperiled prairie ecosystem and its associated organisms. However, the degree to which reconstructed prairies function like remnant prairies has not been fully examined. We evaluated the effect of restoration planting prescriptions, as well as vegetative quality on butterfly communities inhabiting prairie reconstructions in central Iowa, USA. Twelve isolated reconstructed prairies (small, surrounded by agriculture), 12 integrated reconstructions (planting units in a larger matrix of reconstructed and remnant prairies), and 12 remnant prairies were surveyed for butterfly and plant diversity, abundance and composition. Remnant prairies supported significantly higher richness and abundance of habitat-sensitive butterfly species. Butterfly richness on integrated reconstructions was intermediately positioned between remnant and isolated reconstructions. The best vegetative predictors of butterfly richness (R^2 = 0.38) and abundance (R^2 = 0.13) were the availability of nectar and the percent cover of litter (which is related to management issues such as time since burning). Most significantly, we found that the response of the butterfly community to vegetation in a reconstructed prairie is more complex than simply a response to vegetation diversity. Both management within the reconstruction and the landscape context around the reconstruction affect local patterns of butterflies species distribution and abundance. Integrated reconstructions develop richer butterfly communities than isolated reconstructions.

INSECTS, PRAIRIE RESTORATION, AND PRESCRIBED BURNING

Steve Spangler

Little is known about herbivorous insect community-level changes associated with changes in vegetation during prairie and savanna restoration, particularly in “less-studied” groups such as the Hemiptera, Heteroptera, and Coleoptera. Several questions and issues can be asked relative to this statement: (1) Are insect communities on “fully” restored prairies and savannas distinct from those found on the “original” corn-soybean agro-ecosystems?; (2) Are there distinct, recognizable stages of insect community development as restoration proceeds?; (3) Although more “aesthetic” groups such as the butterflies are understandably more studied, there are extremely important less-studied herbivorous groups (e.g., Homoptera, Heteroptera, Coleoptera) in which larger information gaps exist; (4) Similarly, there may be specific insect-plant species associations with these groups which may add valuable new information; (6) How is biodiversity of these insect groups affected by prairie restoration?; (7) Opportunity and needs exist for documenting, preserving and identifying insects for the laboratory facilities at NSNWR.

Preliminary work has been conducted in 2004 and 2005 on comparing different habitats and different sampling techniques.

Relative to the impact of prescribed burning on insect communities, some controversy exists, but much more is known about this relationship. Nonetheless, burning is a regular practice at the NSNWR, and there may be a need to better document this relationship.

BEYOND SITE-SPECIFIC ASSEMBLY RULES: SPECIES TRAITS PREDICT OCCURRENCE OF LEPIDOPTERA IN RESTORED TALLGRASS PRAIRIES

Keith Summerville, Drake University

Abstract (220 words): The goals of this study were to determine whether combinations of ecological traits predispose moth species toward recolonization of restored prairies and to assess the degree to which restored prairies contained moth assemblages comparable with prairie remnants. In 2004, we collected 259 moth species from 13 Tallgrass prairie remnants and restorations in central Iowa. Principal components analysis (PCA) was used to identify significant combinations of ecological traits that were shard by groups of moth species. Logistic regression was then employed to test for significant effects of the trait combinations on the frequency of prairie sites occupied by moth species. PCA partitioned moth traits into four axes that explained a total of 81.6% of the variance. Logistic regression detected significant effects for all four PCA axes on the fraction of sites occupied by moths. Species frequently filtered from the regional species pool into prairies were those that: had long flight periods and were multivoltine, displayed a feeding preference for legumes but not other forb families, and were regionally abundant but relatively small in body size. Ordination revealed significant differences in moth communities among prairies, suggesting that species traits and habitat characteristics likely interact to create observed patterns of species recolonization of restorations. Thus, the optimal approach to restoring the lepidopteran fauna of Tallgrass prairies may involve locating prairie plantings adjacent to habitat remnants.

EVALUATING RESTORATION SUCCESS: ROLES OF GRAZING AND SEED LIMITATION

Brian J. Wilsey, Dept. EEOB, Iowa State University

1. Grassland reconstructions often lack rare forb and grass species that are found in intact grasslands. Possible reasons for low diversity include seed limitation, microsite

limitation, or a combination of both. Native ungulates may create microsites for seedling establishment in tallgrass prairie reconstructions by grazing dominant species or through trampling activities, but this has never been tested in developing prairie reconstructions.
2. We experimentally tested for seed and microsite limitation in the largest tallgrass prairie reconstruction in the U.S.A. by adding rare forb and grass seeds in two trials inside and outside native ungulate exclosures. We measured seedling emergence because this stage is crucial in recruiting species into a community. We also measured light, water and standing crop biomass to test whether resource availability could help explain seedling emergence rates.
3. Ungulates increased light availability for each sampling time and also increased above-ground net primary productivity (ANPP) during summer.
4. Seedling emergence of rare forbs and grasses was consistently greater when we added seeds.
5. Seedling emergence was conditionally greater with a combination of seed additions and grazing, but grazing alone was unable to increase seedling emergence.
6. When ungulates increased seedling enhancement, the mechanism was partially associated with increased water and light availability.
7. Exotic seedling emergence was not affected by grazing.
8. *Synthesis and applications.* These results suggest that grassland reconstructions are primarily seed limited and that grazing alone may not be able to increase seedling emergence of rare species without the addition of seeds.

SURVEY OF MYCORRHIZAL SYMBIOSES AT NEAL SMITH NATIONAL WILDLIFE REFUGE

Inger Lamb, Iowa Native Lands and Iowa Prairie Network, and Scott J. Bryant, Compass Plant Consultants

The symbiotic relationship between prairie plants and certain fungi is critical to the survival of the prairie, as most prairie plant species benefit, and many are dependent on this relationship. A general survey of mycorrhizal occurrence and frequency in a range of different ages of reconstructed prairies at Neal Smith National Wildlife Refuge is undertaken to aid in the understanding of their role in the establishment of prairie plant communities on former agricultural crop land.

Root samples were taken from established prairie plant species on planting sites of the same soil type, varying in age from 11 years to 1 year since planting. The root samples were cleared, stained, and preserved. They are being examined and photographed under a light microscope to detect and document differences in fungal infection over time.

The next phase of this study will involve isolating spores of mycorrhizae from soil cores sampled from the same prairie reconstruction sites, and preserving them for identification.

Northern Prairie Wildlife Research Center

Status report: Evaluation of methods for Canada thistle-free habitat restoration
Diane L. Larson, USGS Northern Prairie Wildlife Research Center
October 20, 2005

Despite Mother Nature's best efforts, this project is on schedule as of October, 2005. Dormant season seedings were completed on schedule, but the soggy spring delayed the spring planting considerably. The last field was seeded in mid-July. Nonetheless, the first year's vegetation evaluations were completed as planned, starting with Neal Smith Refuge, followed by Litchfield, Fergus Falls, and finally Morris. Station personnel participated in evaluations at each site along with a University of Minnesota Botanist and her assistant.

The vegetation evaluations included thistle stem counts on a 2m x 6m plot in the center of each treatment cell and cover estimates for all species within a subset of the central sampling area. Canada thistle stem counts have been entered into a data base and a preliminary analysis suggests a significant site by method interaction, with the highest stem counts on the dormant-seeded plots at all sites; numbers were especially high at Kandiyohi (Litchfield, least square mean = 25.6 stems/plot) and Fahl (Morris, least square mean = 12.2 stems/plot). Because the "spring" seeded plots were sprayed with herbicide prior to seeding, this result is not unexpected. Stem counts in 2006 will better reflect effects of the treatments themselves. There was no evidence of an effect of diversity of seeds planted on thistle stem counts. Notably, no thistle stems were found at either the Harmison or Production sites at Neal Smith Refuge.

The thistle seed bank analysis was completed by cooperators at the Agricultural Research Service in Morris, MN and data were sent to FWS and USGS. These data will be subjected to a geostatistical routine known as kriging to determine variation in densities of propagules across the fields. Soil samples we collected this spring will be analyzed for nitrogen availability and soil texture by University of Minnesota personnel this fall. These data will be used to help explain variation in thistle stems that is unrelated to our treatments.

It will be important to continue monitoring the plots for both thistle counts and establishment of the seeded species over the next two years, as the diversity treatments begin to be expressed. Continued support for a botanist and field assistant will be key to this effort.

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Presenter's Biographical Sketches

Dr. Heidi Asbjornsen is an Assistant Professor of Ecosystem Ecology and Restoration in the Department of Natural Resource Ecology and Management at Iowa State University. Her research interests are focused on restoring ecological structure and function to degraded ecosystems. She currently has research projects working with oak savanna and agricultural ecosystems in the Midwestern U.S. and with montane cloud forests and oak forests in southern Mexico.

Lars Brudvig is a Ph.D. student in the Department of Natural Resource Ecology and Management at Iowa State University. He is interested in the restoration of plant communities and conducting dissertation research on the effects of oak savanna restoration on vegetation structure, diversity, and oak regeneration.

Cindy Cambardella received a B.S. in Microbiology and Chemistry from the University of Maryland (College Park, MD) and a Ph.D in Soil Ecology and Ecosystem Science from Colorado State University (Ft. Collins, CO). She is a Research Soil Scientist with the USDA-ARS at the National Soil Tilth Laboratory in Ames, IA, and Associate Professor of Soil Science in the Department of Agronomy at Iowa State University. Her research program is focused on understanding the interrelationships among plant roots, soil organic matter, soil aggregate structure and the cycling of C and N in natural and managed ecosystems. She is interested in understanding how changes in climate, land-use and agricultural management impact soil and water quality through their effects on C accumulation and partitioning in soil, N-use efficiency, and the formation and stabilization of soil aggregates. In order to assess how small-scale changes in soil biochemical processes and properties affect ecosystem parameters defined at larger scales, she is interested in describing the spatial and temporal patterns of these soil processes and properties. She is also involved in interpreting how these patterns affect critical ecosystem response variables (ie organic matter turnover, C storage, N cycling, nitrate leaching, etc.).

Tom Isenhart is an Associate Professor in the Department of Natural Resource Ecology and Management at Iowa State University. His research is focused on stream and watershed ecology. This research addresses the design and establishment of landscape buffers to improve the environmental efficiency of agriculture; ecosystem restoration effects on aquatic integrity; and the biogeochemistry of nitrogen in agroecosystems.

Beth E. Larabee received a Master of Science in Soil Science – Morphology and Genesis, and a Bachelor of Science in Agronomy from Iowa State University. In

addition, she earned an Associate of Arts degree in Drafting Technology from Johnson Community College, and attended the University of Nebraska in Lincoln.
Her Master's Thesis was entitled: Palms and Klossner representative pedons on the Des Moines Lobe in Iowa, 1950 to 2001. Ms. Larabee's current ISU Extension projects include: Living Roadway Trust Fund Prairie Water Infiltration Study, the Iowa Learning Farm, the Long Term Tillage, and Bt vs non Bt Corn Residue Decomposition. Professional interests include prairie restoration, sustainable agriculture, environmental issues, and public education.

Dr. Matt Helmers is an Assistant Professor and Extension Agricultural Engineer in the Department of Agricultural and Biosystems Engineering at Iowa State University. Dr. Helmers is a native Iowan and received his PhD from the University of Nebraska-Lincoln where he studied two-dimensional overland flow and sediment trapping in vegetative filters. His research and extension focus at Iowa State is in the areas of water quality and water resources management. In particular, he is studying water quality effects of agricultural best management practices including strategic placement and design of buffer systems and methods to improve water quality in tile drained landscapes.

Tom Sauer is a soil scientist in the Air Quality of Agricultural Systems research unit at the National Soil Tilth Laboratory in Ames, Iowa and is the lead scientist on the unit's global climate change project "Trace gas exchanges in Midwest cropping systems". He has research interests in soil-atmosphere interactions and effects of land use changes on greenhouse gas fluxes and soil quality.

Keith E. Schilling is a research geologist at the Iowa Geological Survey. He received a B.A. degree in Geology from Knox College and an M.S. degree in Water Resources from Iowa State University. Keith joined the Iowa Geological Survey in 1997 after working as a Senior Hydrogeologist for a environmental engineering firm where he specialized in contaminated site investigation and remediation. Keith is currently responsible for Walnut Creek Watershed Restoration and Water Quality Monitoring Project in Jasper County, the site of a large-scale conversion of row crop to prairie at the Neal Smith National Wildlife Refuge. Keith also conducts research on a variety of other water-related issues in Iowa, including surface and groundwater interactions, groundwater flow and quality, and watershed processes.

Dr. Lisa Schulte is an assistant professor of landscape ecology at Iowa State University. Her research focuses on landscape patterns and dynamics, emphasizing change across long time periods and broad spatial scales. She studies forests of the northern Great Lakes region and Midwestern Driftless Area, and agroecosystems of the U.S. Corn Belt.

Steve Spangler holds a Ph.D in Entomology (Penn State University), a M.S. in Biology Ecology (Utah State University), and a B.A. in Biology (Lake Forest College).
He has worked as an agronomist, extension entomologist (field crops, fruits, and vegetables), and insect ecologist for the Monsanto Company, Penn State University, Cornell University and a small environmental consulting company (Bio-Resources, Inc.), respectively. Dr. Spangler has published ten refereed publications (5 senior author)

Dr. Keith Summerville is an assistant professor of Environmental Science & Policy at Drake University. Prior to coming to Iowa, Keith earned his Ph. D. from Miami University in Ohio while developing a research agenda aimed at increasing our understanding of how forest fragmentation and timber management alter the structure and composition of insect communities. Currently, Keith's reseach has turned to the restoration ecology of prairie butterfly and moth communities. Papers from research done at Neal Smith have recently been published or accepted for publication in the journals Restoration Ecology and Ecological Applications.

Mark Tomer is a Soil Scientist and Hydrologist with the National Soil Tilth Laboratory of the USDA's Agricultural Research Service. He has held this position since 2000. Mark's background includes a BS in Forestry from Montana, an MS in Soil Physics from Montana State, and a PhD in Soil Science and Water Resources from the University of Minnesota. His past experience includes work on salinity control projects in eastern Montana, and wastewater irrigation research in New Zealand. His current research is focused on determining soil and hydrologic responses to land-use practices at watershed and hillslope scales, with a particular interest in the evaluation of agricultural conservation practices.

Addendum to Biographical Sketches

Dr. Keith Summerville is an assistant professor of Environmental Science & Policy at Drake University. Prior to coming to Iowa, Keith earned his Ph. D. from Miami University in Ohio while developing a research agenda aimed at increasing our understanding of how forest fragmentation and timber management alter the structure and composition of insect communities. Currently, Keith's reseach has turned to the restoration ecology of prairie butterfly and moth communities. Papers from research done at Neal Smith have recently been published or accepted for publication in the journals Restoration Ecology and Ecological Applications.

THE EFFECTS OF VARYING SEEDING RATES OF *BOUTELOUA CURTIPENDULA* AND MOWING ON NATIVE PLANT ESTABLISHMENT IN A NEW PRAIRIE RECONSTRUCTION.

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A major problem in prairie reconstruction is weed competition. Research has shown that mowing in the first year can increase emergence and survival of prairie plants. The use of nurse crops (companion crops) has been suggested as an alternative to mowing for weed suppression. The goal of this study is to examine varying seeding rates of *B. curtipendula*, as a nurse crop in mowed and un-mowed plots to see if it can successfully suppress weeds without reducing the establishment of seeded natives. We hypothesize that increasing the seeding rate of *B curtipendula* will reduce weed growth and promote an increase in native seedling numbers. In addition we hypothesize that number of the native seedlings in mowed plots with no *B. curtipendula* seed will be similar to un-mowed plots seeded with *B. curtipendula*. Seeds from 25 different species of grasses and forbs were broadcast on June 18th at Neal Smith Wildlife Refuge at a seeding rate of 2 seeds/ft^2. *B. curtipendula* was also broadcast at seeding rates of 0, 2, 4, 16, and 32 seeds/ft^2. The site was mowed mid-August and sampled early September 2005. Native seedling counts, biomass clippings, basal cover, and photosynthetic light were measured. Results from this first growing season show no significant difference ($p>0.05$) between seeding rates and mowing in total native species composition.